LE-600 Turbine

Installation & Operation Guide

1.55m Diameter Micro Wind Turbine for generating clean and renewable electricity anywhere the wind blows…

Leading Edge Turbines Ltd

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Introduction

Please read this manual thoroughly before attempting to assemble, install or operate your *LE-600* small wind turbine. This will assure optimum performance and safety.

Leading Edge Turbines have spent many years developing the ideas and technology behind your turbine. The *LE-600 turbine* features an array of innovations and construction techniques as well as heavy-duty engineering to ensure optimum efficiency and a long operating life.

The *LE-600* has been designed to be simple, economic, durable and yield excellent performance.

Your *LE-600 turbine* features:

- Innovatively designed axial flux alternator, using neodymium iron boron magnets
- A laser-cut, aluminium chassis using 'Yaw-wing' design to ensure responsive yawing
- Maintenance-free, low friction bearing arrangements
- Extremely quiet injection moulded blades with 'Whispower' geometry and aerofoil design
- Long-life yaw pivot slip-rings and wipers
- Easy tower-top installation
- Simple design for low cost and longevity
- Fully marinised using stainless steel fixings and anodised aluminium components
- Low mass to help reduce exerted forces and ensure easy installation
- Lightweight aluminium design.

The *LE-600* has been developed for both land-based and marine environments. Thanks to its unique design, the *LE-600* is not susceptible to corrosion in normal or salt water operating conditions.

Applications include:

- Marine
- Remote Homes / Caravans
- Street lighting and road signage
- Complementary installation with photovoltaic modules for home power
- Farm utilities (electric fencing, irrigation, etc.)
- Wind-electric water pumping
- Cathodic protection
- Monitoring sites
- Telecommunications
- The Developing World

Safety Precautions

Safety must always be your primary concern during the assembly, installation and operation of your *LE-600 turbine*. Always be aware of the risks involved with mechanical and electrical installation work. If in doubt about any issue regarding your turbine, please seek further assistance before proceeding. Installation of the LE-600 turbine should only be undertaken by suitably competent and qualified personnel.

Mechanical Safety Hazards

- The main rotor is the most obvious and serious mechanical safety risk. When the turbine is operating at its rated performance, the blades will be very difficult to see due to the speed of rotation. Never approach the turbine whilst it is operating. Always shut down the turbine by activating the stop switch. **Ensure that the turbine is installed in a suitable position where nobody can approach or interfere with the path of the rotor blades.**
- Working with tools of any kind can be dangerous. Your *LE-600 turbine* requires some basic mechanical assembly with rudimentary hand tools. If you are in any doubt about how to use these tools correctly, please seek advice from a suitably experienced person.
- Your *LE-600 turbine* will inevitably be installed upon a tower or other support mount. This may mean working at height. Always ensure that all personnel in the immediate vicinity are aware of any lifting / hoisting operations that will be occurring. Check there are no loose components or tools likely to fall and cause injury during the lifting operation. Where possible, all assembly work should be completed at ground level. In the case of roof mount brackets, a suitable fitter should carry out the installation with the appropriate equipment for working at height.
- Ensure that the batteries are disconnected during the installation procedure.
- Twist the turbine output cables together (to create a short circuit) during the mechanical installation process. This will prevent the turbine from 'spinning up' during the installation.
- Never install the turbine upside down or in any orientation other than that depicted on the installation instructions.
- Install your turbine during a calm day.
- When performing routine inspection or maintenance, always stop the turbine by activating the stop switch.

Electrical Safety Hazards

- The *LE-600* generates 3-Phase AC voltage from the turbine head and rectified DC voltage from the rectifier box. Even at low voltages there are inherent risks. Caution should always be used when connecting *LE-600* to the electrical system.
- Ensure that you have followed the cable-sizing chart to ensure that the correct size of transmission cable has been selected. If a cable of insufficient cross-sectional area is used, heat may build up in the cables causing a potential fire hazard. A properly sized fuse or circuit breaker should be used in the cables connected to the battery. This will stop the risk of short circuit currents. Using cables of insufficient cross-sectional area may also reduce the power transmission efficiency of the turbine.
- Batteries systems can deliver a serious amount of current. A short circuit in the battery circuit can lead to hundreds of amps flowing through the battery cables. This will cause a heat build-up and ultimately an electrical fire. Batteries can explode when shorted. Always use insulated electrical tools when working on the battery's electrical connections.
- Batteries are very heavy. Do not attempt to move batteries by yourself. Always use manual handling tools and an assistant.
- Always keep lead-acid batteries the correct way up. Do not allow the acidic electrolyte to spill or come into contact with your skin or face. Always follow the manufacturer's safety instructions when handling lead-acid batteries.
- Never run the LE-600 'off-load' with the output cables not connected to anything.

Please use common sense when installing and operating your turbine!

Specifications

Turbine Name: *LE-600 Turbine*
Part Number: GA-LETU-009
Nominal Voltage: 12V / 24V / 48V or Grid-tie optimised

Rotor Diameter: 1540 mm
Rated Wind Velocity: 7.2 m/s
Rated Output: 160 Watts
Max Output: 600 Watts (900 Watts in certain applications)
Rated RPM: 550
Start-up Wind Velocity: 2 m/s
Total weight: 19.5 Kg
Tower mount: 60.3 mm Outer Diameter Tube x 3 / 4 mm Wall
Chassis Construction: Aluminium
Rotor Blades (3-off): Glass Reinforced Nylon

Fig-1: Diametric View

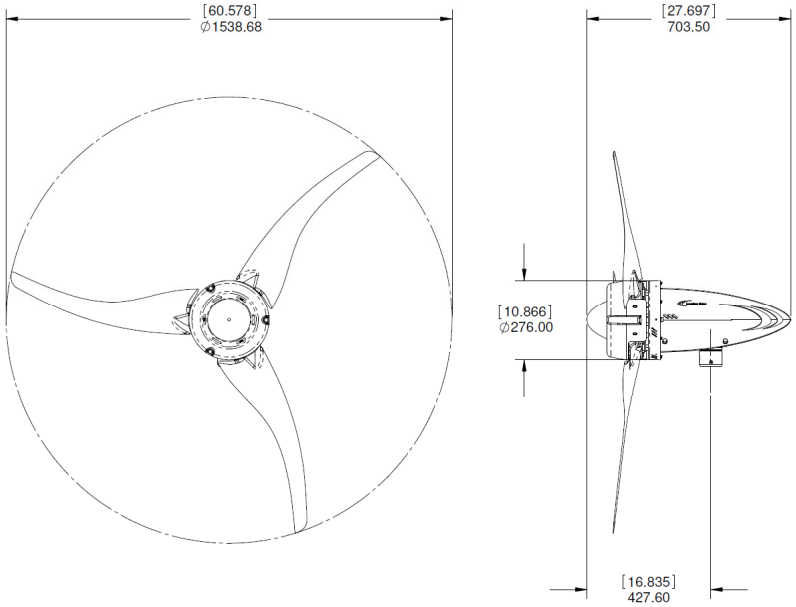


Fig-2: Operating Envelope

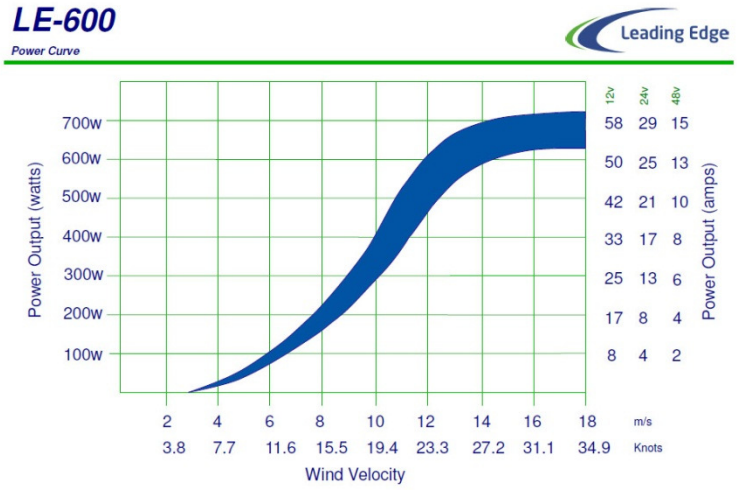
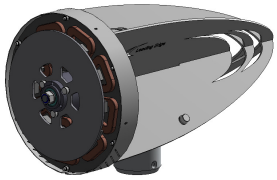


Fig-3: Energy Conversion

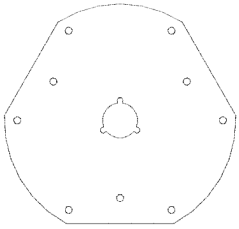
Package Contents

Your *LE-600 Turbine* will arrive containing the components shown below. If any of the components are missing or damaged, please contact your dealer immediately.



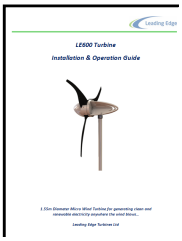
LE300 Chassis: Qty 1

Rotor Blade: Qty 3



Hub Plate: Qty 1

Nose Cone: Qty 1



User Manual: Qty 1

3 x	M6 x16 Cap Heads
9 x	M8 x 60 Hex Heads
3 x	M6 Washers
12x	M8 Nylock Nuts
18 x	M8 Washers
3x	M8 x 12lg Cap Head

Fixings Bag: Qty 1

Tools Required For Assembly

You will require the following tools to assemble your *LE-600 Turbine*:

- 10mm A/F spanner & 10 mm ratchet (one of each required)
- 13mm A/F spanner & 13 mm ratchet (one of each required)
- A Set of Metric Standard Hexagon Keys
- Electrical screw drivers
- Power drill
- 6.5 mm & 3.0 mm diameter twist drill bit, suitable for drilling through steel
- Digital multi-meter capable of measuring DC & AC Volts
- Tape measure or steel rule
- Thread-locking compound (Loctite 243 or similar)

Mechanical Assembly Procedure

1) ***Unpacking -*** Inspect the contents of the box and ensure that all items are present and free from damage. If any of the components are missing or damaged, please contact your dealer immediately.
2) ***Check Magnet Rotor & Continuity -*** Ensure that the main shaft is free turning and does not scrape or rub as it rotates - see Fig-4. You may feel a slight resistance from the bearings at this stage. The bearing units used in the magnet rotor assembly are factory lubricated and sealed for life. It will take approximately 100 hours of normal operation for the bearing seals to 'bed-in' and the lubrication to be distributed correctly around the raceways and ball cages. During this period you may notice a reduced performance caused by the additional friction of the bearing seals. In operating temperatures of –10 degrees Centigrade or lower, this 'bedding-in' period will be extended by a further 50 hours of normal operation. Connect a digital multi-meter to any two of the three output leads extending from the yaw pivot. With the multi-meter set to detect AC Volts (0-20V), a voltage should be displayed when the magnet rotor is spun. This voltage will vary with the speed of rotation. If the magnet rotor rubs, or no voltage is detected whilst turning the magnet rotor, please contact your dealer immediately.

Warning: The magnet rotor within your *LE-600 Turbine* is constructed using neodymium iron boron rare earth magnets which are semi-exposed until the turbine is fully assembled. These are extremely powerful magnets and can cause injury if not handled with respect. Take care when working with tools made of ferrous materials (such as spanners and screwdrivers) close to LE-600 alternator. The magnetic forces between ferrous materials and the magnet rotor within the alternator may be very strong. This may cause a sudden snapping action that can pinch or trap your fingers or skin.

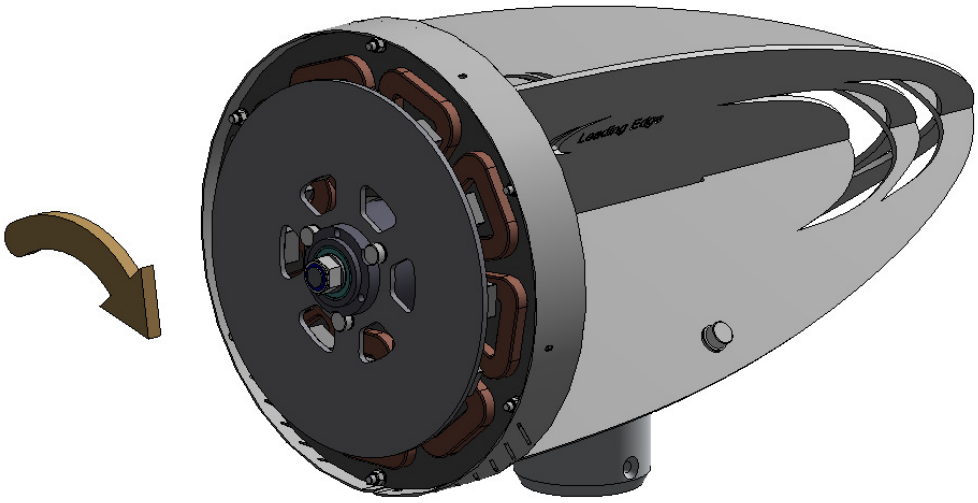


Fig-4: Checking magnet rotor rotation and coil-disc continuity

3) ***Rotor Blade Assembly -*** Take the three rotor blades and rotor hub plate. Be careful when handling the blades, they have ***VERY SHARP EDGES***. Use a 13 mm A/F socket and hexagon key and three M8 x 60mm long set screws to attach each blade to the hub plate - see Fig-5. Ensure that the cap head end of the screw is on the rotor hub plate side (thus allowing the washers and nuts to locate inside of the blades. The blades should all be fixed to the hub plate on the same side, with the blades in the same orientation. It is important that a washer is used underneath the anti-vibration nuts. 3 set-screws, 3 washers and 3 anti-vibration nuts should be used on each blade. Tighten the fixings until the blades are safely secured. Do not over-tighten the nuts as this may damage the blades and fixings.

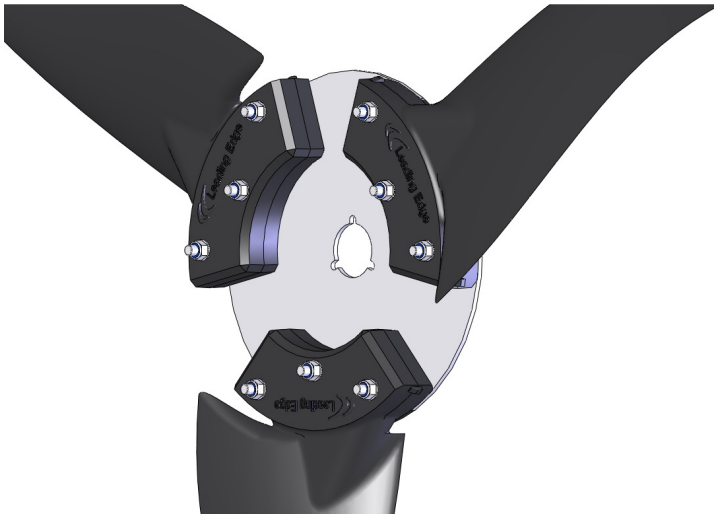


Fig-5: Attaching the 3 rotor blades to the hub plate

4) ***Check the Tip Spacing -*** Although the turbine blades are fitted with location 'keyways', it is important to check the tip spacing. Lay the assembled rotor blade on a flat surface. Using a tape measure or long steel rule ensure that the spacing between each tip is equal to within a tolerance of +/-1.5 mm. Adjust the blades as required. Output performance may suffer if the blades are inaccurately set - see Fig-6.

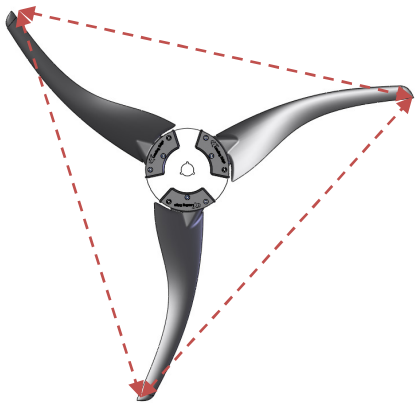


Fig-6: Checking tip spacing

NOTE: Depending on the type of support structure being utilised for the LE-600, it is sometimes advisable to fit the main rotor set to the turbine chassis at this stage. However in other circumstances it will be easier to fit the turbine chassis to the support structure before fitting the main rotor set. The installer must use judgement as to the best order in which to fit the turbine together, depending on the merits of the installation and therefore the remaining installation steps maybe completed in an alternative sequence.

5) ***Fit the Rotor Blade Assembly -*** This is done by offering the rotor hub plate against the drive hub protruding from the front of the chassis. M6 x 16 long cap head screws should then be used to fix the rotor hub in position using the three unused tapped holes in the drive shaft. Ensure that all 3 screws are securely tightened and that the rotor blades are fitted with the flat side of the blade facing towards the magnet rotor. Thread-locking compound should be used on the screw threads.

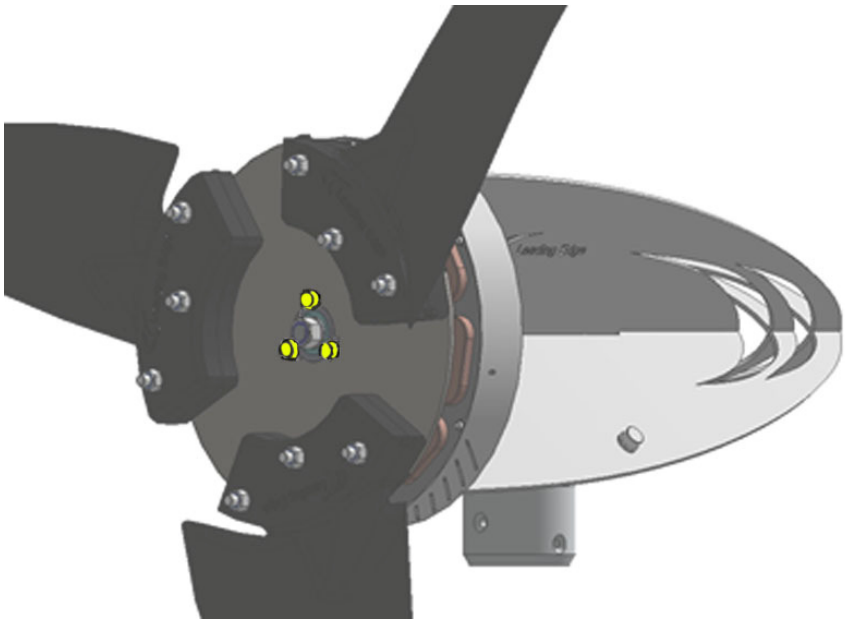


Fig-7: Fitting the rotor blades to the chassis

6) ***Check the blade rotation -*** Once the blades have been fitted and secured to the chassis, ensure that they rotate freely. Take this opportunity to check that all of the blade and hub fixings are secure - see Fig-8.

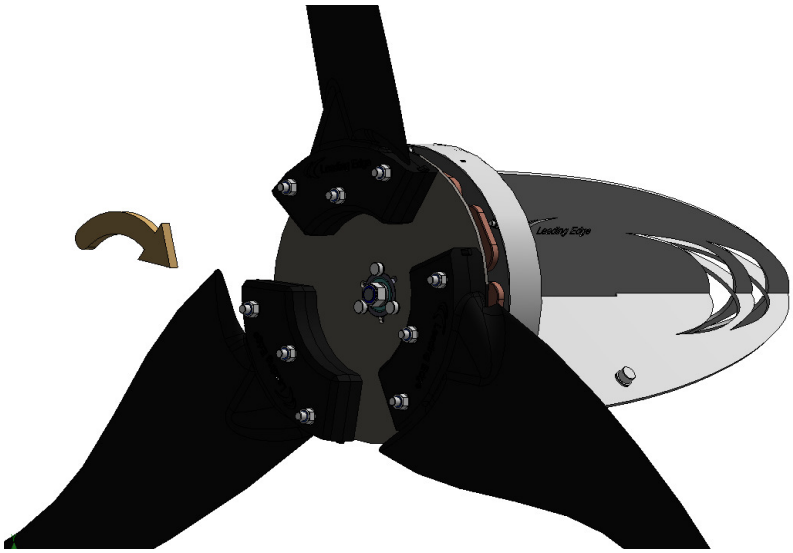


Fig-8: Check blade rotation

7) ***Fit the nose cone -*** The nose cone can now be fitted to the rotor. This is done by aligning the mounting slots of the nose cone with the corresponding 'barbs' on the rotor blades. Once the nose cone is fitted correctly over the blades and runs concentrically, fix it in position using Qty 3 M8 x 12lg Cap head screws. The screws enter through the mount holes in the nose cone and align with the 3 tapped holes in the hub plate. Ensure that the nose cone is secure and true before finally tightening the fixings.

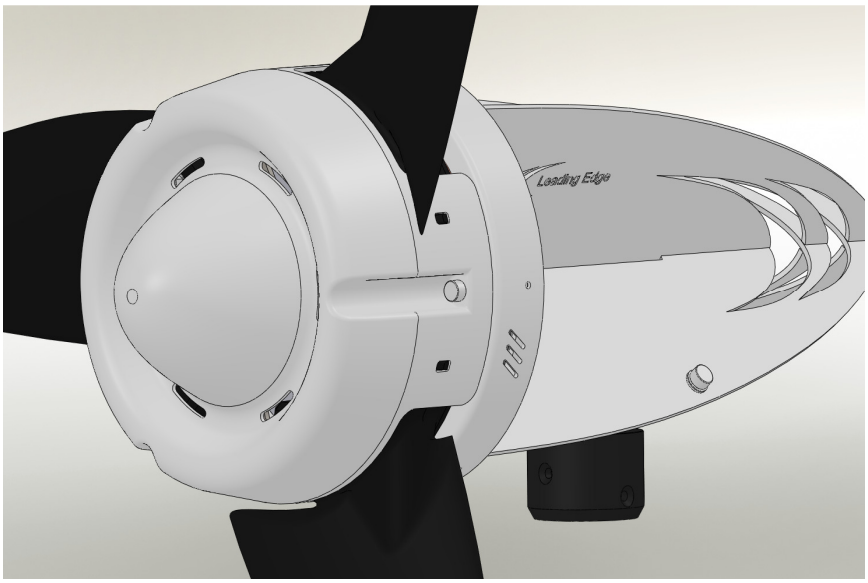


Fig-9: Attach the nose cone

8) ***Prepare the Turbine Mount -*** If you have purchased a *LE-600* mount bracket or tower from a *Leading Edge Turbines'* dealer, then please refer to the separate installation instructions supplied with the product. If you have sourced your own tower / mount bracket, 7 mm diameter holes will need to be drilled in order to secure the turbine. These holes should be drilled 10 mm and 25 mm from the top of the tower / mount bracket and should be perpendicular to the surface and skewed by 90 degrees. The hole should penetrate both sides and cross the centre line of the tubular section - see Fig-10.

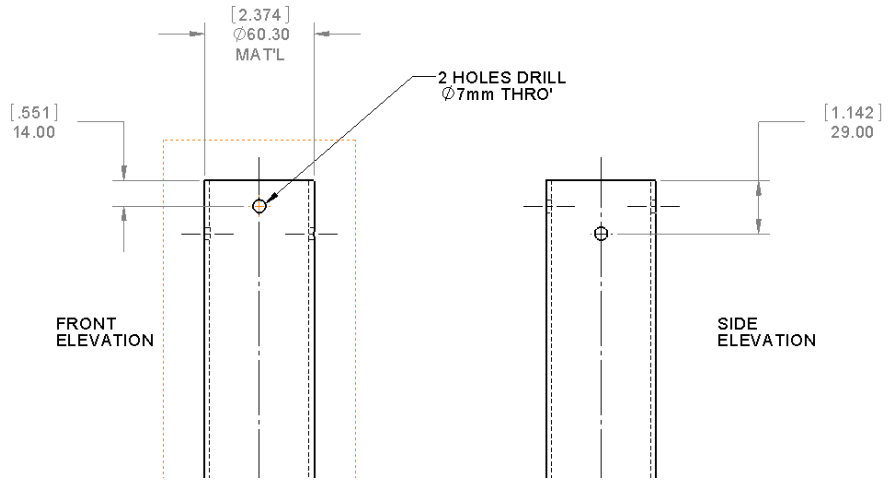


Fig-10: Drill through top of tower / mount bracket

9) ***Install the Transmission Cables -*** When your tower or mount bracket is ready to receive its turbine, the next stage is to run the cables from the top of the tower to where the rectifier box / electrical controller and batteries / grid-tie inverter will be located. Follow the table below to select the correct wire size (cross-sectional area). This will vary depending on your nominal battery voltage and the distance that the cables will be run. Careful selection of the cable size is required. It will not only affect the safety of the system, but also the overall efficiency. A cable of insufficient cable size will cause a voltage drop, wasting the power that has been generated. The cable sizes listed below have been selected with efficiency and cost in mind, as it is unlikely that your turbine will be running at full capacity 100% of the time. If in doubt, consult your local electrical supplier. The cable should be installed in accordance with local electrical regulations and guidelines. If in doubt, use a local electrical contractor to complete the cable installation.

Warning: If a cable of insufficient cross-sectional area is used, heat will build up in the cables causing a potential fire hazard. Cable capacities quoted below are based upon 'Tri-Rated' cables (BS6231).

	Transmission Distance		
***LE-600* Nominal Output Voltage or GT Variant**	10 Metres	25 Metres	50 Metres
12 Volts	16 mm² (3-Core)	25 mm² (3-Core)	50 mm² (3-Core)
24 Volts	4 mm² (3-Core)	10 mm² (3-Core)	16 mm² (3-Core)
48 Volts	1.5 mm² (3-Core)	2.5 mm² (3-Core)	4 mm² (3-Core)
GT1 (25-110 Volts)	1.5 mm² (3-Core)	2.5 mm² (3-Core)	4 mm² (3-Core)

10) ***Mount the LE-600 Turbine onto the Support Structure -*** Ensure that the previously installed power transmission cables are not yet connected to any batteries and are 'shorted' together. This will prevent the turbine from operating during the installation process. Once this has been done, connect the turbine output cables to the transmission cables using a connecter supplied by Leading Edge Turbines (supplied separately) or a suitable terminal block with a minimum rating of 75 Amps (12V), 40 Amps (24V), 25 Amps (48V), 20 Amps (GT1). Offer the turbine up to the support structure and push the turbine body onto the tower. Ensure that no cables are snagged. Use the M6 x 75 countersunk set-screws along with washers and thread-locking compound to secure the turbine using the holes previously drilled in the support structure - see Fig-11. Ensure that the M6 set-screws are securely fastened.

Fig-11: Fitting the turbine onto the support structure

Electrical Installation

Please refer to Figs 12 - 14 for appropriate generic wiring diagrams. In a battery charging renewable energy system, there may be different ways of wiring small wind turbines, photovoltaic panels, charge controllers and batteries together. This type of system will often expand 'organically', but the following guidelines should be followed:

- ***Follow the appropriate electrical code -*** The electrical wiring of your *LE-600* turbine and associated electrical systems must be done in accordance with national and local electrical codes and regulations.

- ***Do not connect the turbine or batteries during the installation -*** Ensure that the turbine is not running or connected to the batteries during the installation or wiring process. Connect the output cables of the turbine together to prevent the rotor from starting up.

- ***Galvanic corrosion of electrical joints -*** Try to avoid connections between dissimilar metals. For example, connecting copper and aluminium together will result in galvanic corrosion of the connection. This will increase the electrical resistance of the connection (wasting energy), and reduce the mechanical integrity of the joint. Where possible, use a fluxed solder to make electrical joints.

- ***Protect the cables -*** The power transmission cables must be protected from mechanical damage and fatigue. Run the cables through an approved conduit / trunking.

- ***Cable strain relief -*** Prevent mechanical strain on the transmission cables running down the tower from the turbine. Clip the cables to the inside of the tower. Failure to do this will result in excessive mechanical strain on the cable joints within the slip-ring assembly and may cause a failure. Cable ties or cable glands are a good way to prevent mechanical strain on the cables.

- ***'Earth' the System -*** The turbine tower should have its own separate earth point. The negative terminal of the battery bank should also be earthed. This provides protection against the build-up of static and lightning strikes. The tower should be earthed separately with its own ground rod if there is a long transmission distance between the tower and batteries. An appropriate surge arrestor could also be used to help prevent damage to the battery charging system during a lightning strike. Ensure that the earth cables are of the same rating as the positive and negative cables.

- ***Cable Selection -*** The cable size table should be used to select the minimum sized cable for a given transmission distance. Voltage drop in the cable will be improved if a larger cable is used. We recommend using 'Tri-Rated' cable as it should comply with the wiring codes for your area.

- ***Fuses -*** The turbine and charging circuit should be protected with a suitably rated 'slow-blow' DC fuse or DC circuit breaker. Please refer to the table below for the correct rating. The fuse or breaker should be positioned between the turbine and batteries (on the positive cable). If a stop switch is used (recommended) the fuse should be positioned between the switch and the batteries.

LE-600 Nominal Output Voltage	***DC Fuse / DC Circuit Breaker Rating***
12 V	60 Amp
24 V	30 Amp
48 V	20 Amp
GT1	16 Amp

- ***Run / Stop Switch -*** A simple switch arrangement can provide a safe and easy way of stopping the turbine during high winds or for maintenance. *Leading Edge Turbines* can supply a switch which is best for this purpose. As the switch is thrown, the batteries are disconnected and the turbine is 'shorted' reducing the rotor to a slow rotation. Refer to the generic wiring diagrams.

- ***Charge Controllers -*** Two LE-DL-300 Diversion Charge Controllers are recommended to manage the power output from the turbine to the batteries. These diversion charge controllers operate by increasingly switching output to a dump load once the batteries begin to reach high voltages. The dump load consumes the 'excess' power from the turbine. This means that the turbine's power output is always utilised whether the batteries are fully charged or not. Larger capacity battery banks will be able to store more energy and so the dump load will be used less. Do not use a photovoltaic type charge controller with your LE-600 turbine. For hybrid or more complex systems, we recommend that a 45 A or 60 A Diversion Controller is utilised together with a separate dump load.

- ***'Hybrid' Systems -*** The *LE-600 Turbine* can be used in parallel with PV panels. We recommend that the PV panels are wired independently with a separate charge controller specifically designed for use with PV panels and connected in parallel with the battery bank - see Fig-13. For hybrid or more complex systems, we recommend that a 45 A or 60 A Diversion Controller is utilised together with a separate dump load.

- ***Use of Grid-tie Inverters -*** It is possible to connect your *LE-600* to a grid-tie (grid connect) inverter. It is recommended that only grid-tie inverters supplied by *Leading Edge Turbines* are used to ensure that an appropriate MPPT curve has been programmed.

Please refer to the following wiring diagrams as a guide.

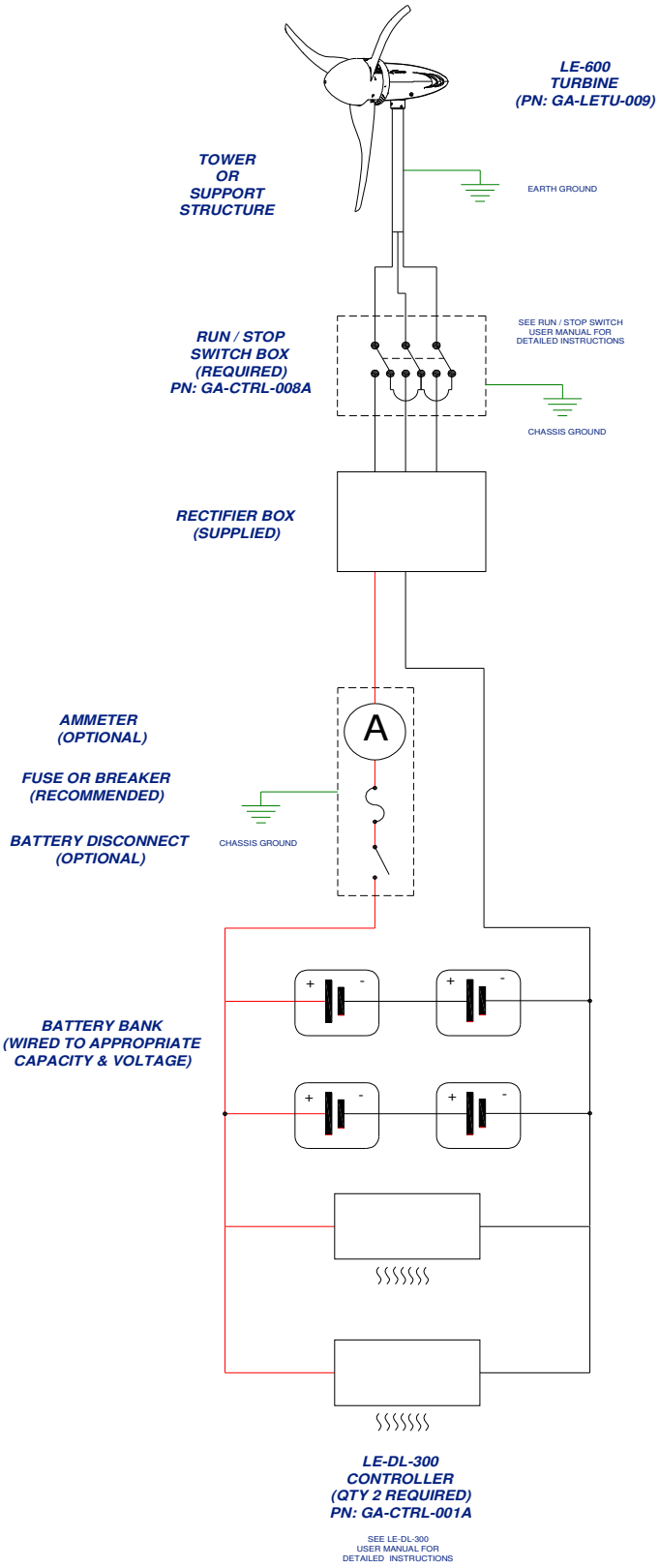


Fig-12: Typical 'Stand-Alone' Battery Charging Wiring Diagram

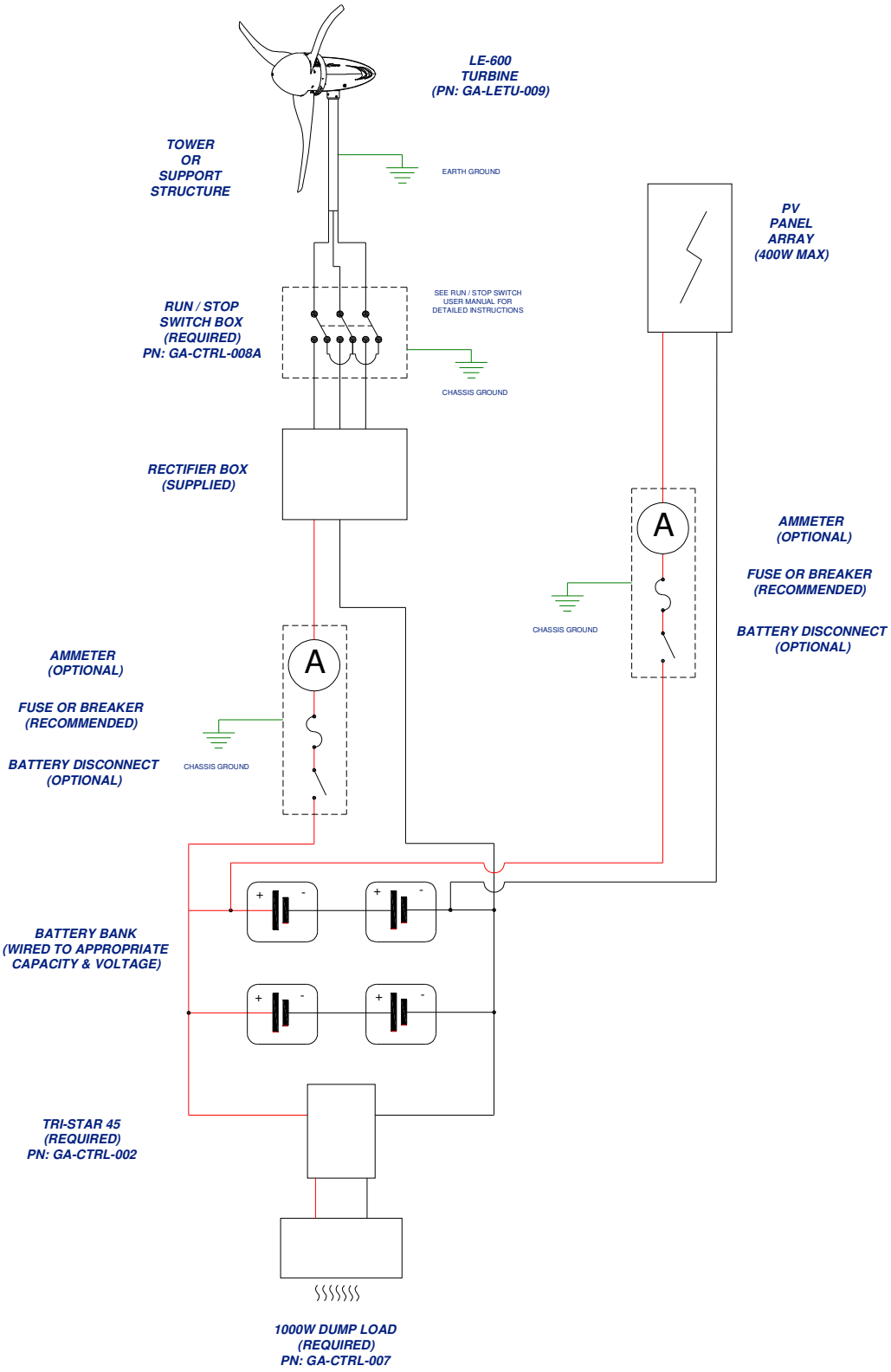


Fig-13: Typical 'Hybrid' Wind /PV System Wiring Diagram

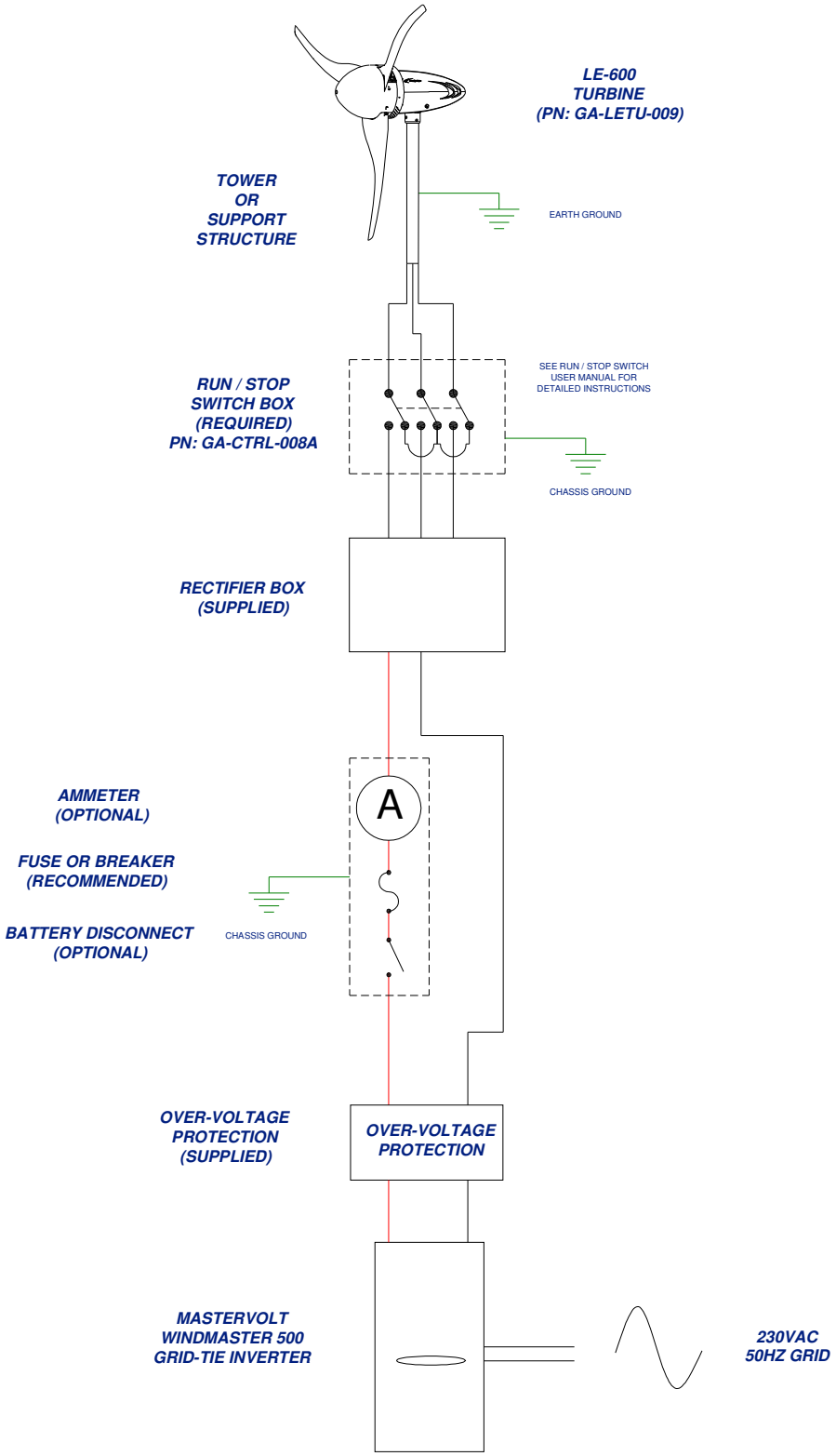


Fig-14: Typical 'Grid-tie' System Wiring Diagram

Turbine Operation

The *LE-600 Turbine* is based on a simple design for ease of installation and reliable operation. You may notice the following behaviour during normal operation:

- ***Cut-in -*** The turbine will not begin to charge the batteries until the rotor is spinning at approximately 290 RPM. Whilst operating below this speed, the turbine will be 'off-load' and freewheeling. Once the turbine output voltage becomes equal to the nominal battery voltage (at around 290 RPM), the turbine will come 'on-load' and begin to deliver current to the batteries. During the off-load stages of rotation, the blades will rotate very freely. This allows the rotor to build up speed and allows aerodynamic lift to be generated by the blades.

- ***Normal Operation -*** Once the rotor is spinning more than 290 RPM, current will be delivered to the batteries. As the rotor speed increases, so too will the current and voltage. Excessive wind speed may increase the battery voltage to a high level. Once this happens the diversion charge controller will recognise that the battery voltage is too high and begin 'dumping' power to the heater module.

- ***Charge Regulation -*** Once the charge controller has switched over to the dump load, the turbine will no longer be charging the batteries. Instead the power from the turbine will be delivered to the dump load (usually a resistive heater element). The battery voltage will begin to drop to normal levels during the regulation period. Once the battery voltage is back within acceptable limits, the charge controller will switch the turbine output back to the batteries. Refer to the Charge Controller User Manual for specific operational instructions. This arrangement is more effective than stop/starting the turbine incessantly.

- ***Shut Down -*** By activating the stop switch, the output from the cables of the turbine are 'shorted' together. This effectively puts an infinite load on the generator causing the turbine to stall. When the stop switch is activated, the turbine may still rotate slowly during high winds, but the rotor blades will not be able to build up any significant speed. It is not recommended that the stop switch is activated whilst the rotor is spinning at high speed. This sudden braking action will stress the blades and other components. Only activate the stop switch during a 'lull' when the rotor is not spinning excessively fast.

  Very high winds - Due to the configuration of the low friction, high efficiency alternator, the electromagnetic braking effect is not as strong as with more conventionally designed turbines. In certain high wind conditions, the rotor can overcome the electromagnetic braking, which allows high currents to be produced in the stator coils. If this situation occurs with the wind driving the braked alternator for prolonged periods, damage to the turbine will occur. Therefore the braking switch should only be used to slow the unit prior to manually / mechanically tethering the turbine in during very high winds.

- ***High Winds -*** Every effort has been taken to ensure that the *LE-600* will withstand the forces exerted by strong winds. However, the raw power in high winds is immense and the stresses placed upon the turbine are magnified by gusty and turbulent conditions. Where possible the turbine should be shut down and tethered in advance of particularly strong winds (60+ MPH) and storm conditions. This will decrease the wear and tear on the machine and will help to avoid a failure. Protect the turbine from extreme winds as you would protect other items of your property.

- ***Grid-tie Applications -*** When connected to a grid-tie inverter, the *LE-600* will operate in much the same manner as when it is charging batteries (except for the use of dump loads). It is important that the grid-tie inverter characteristics are matched to the power curve of the turbine to ensure optimum performance. An appropriate electrical interface may also be required depending on the inverter equipment being used. It is generally only recommended that *Leading Edge Turbines* approved and programmed inverters be used with the *LE-600*. Refer to your *Leading Edge Turbines'* dealer for more information on this.

Note: Never allow the turbine to run off-load with no connection to a battery bank or grid-tie inverter. Doing so will allow open-circuit voltages to be generated by the turbine. These voltages may be dangerous and may damage the stator coils within the turbine.

Maintenance

Please follow the preventive maintenance programme listed below. This will ensure that the turbine operates reliably and safely with good efficiency.

Always shut down the turbine before attempting to carry out maintenance.

Post-installation Checks (to be carried out one month after installation):

- Check that the tower mount pins are secure and have not worked loose. Adjust if required.
- Ensure that the rotor hub is still securely fitted.
- Ensure that the rotor blades rotate freely.
- Monitor the output. Ensure that the turbine and charge controller are functioning correctly.

Annual Maintenance:

- Inspect the tower / support structure.
- Remove the turbine from its installation to a suitable workbench.
- Remove the rotor blade assembly
- Inspect the edges of the rotor blades for damage such as dents or chips. The blades will become unbalanced if they are damaged. This will cause vibration, noise and poor performance. If many dents have occurred along the edges of the blades, a new set of rotor blades should be fitted (part numbers available in the Spares section).
- Inspect the roots of the blades (attachment tabs) for signs of stress cracking or fatigue. A new set of rotor blades should be fitted if any cracks of fractures have occurred (part numbers available in the Spares section).
- Remove any build-up of dirt and debris from the rotor blades using a mild detergent and warm water.
- Check the blade hub fixings for tightness.
- Carefully remove the yaw mount bracket by unscrewing the 4 connection screws from the sides of the LE-600 chassis. Inspect the slip rings and wipers for obvious signs of wear. Replace the wipers if required (part numbers available in the Spares section). Reassemble the yaw pivot carefully (do not pinch any cables).
- Check that all electrical connections are sound and free from corrosion.
- Generally ensure that the turbine is in good working condition and is safe for continued use.

After five years of normal operation:

- We recommend that the rotor bearings and rotor blades should be replaced after five years of continuous operation. This will ensure that the turbine's performance and safety are not compromised.

Other Considerations:

- The equipment used in the charging system (batteries, charge controller, PV panels, invertors, etc.) should be maintained according to the instructions published by the relevant manufacturer.
- Where lead-acid batteries are used, it is especially important that they are maintained carefully. Failure to do so will result in the batteries being rendered useless within a short period of time.

Spares

The following components may need to be replaced during the service life of your *LE-600* turbine. Please contact your nearest *Leading Edge Turbines'* Dealer, and quote the part numbers listed below.

Rotor Blade (qty 3 matched set):	DP-LETU-041G
Slip Ring Wiper (qty 1):	DP-LETU-185
Slip Ring (qty 1):	DP-LETU-140
Coil-disc (12 VDC):	SA-LETU-005/12V
Coil-disc (24 VDC):	SA-LETU-005/24V
Coil-disc (48 VDC):	SA-LETU-005 /48V
Coil-disc (GT1):	SA-LETU-005 /GT1
Yaw Bearings & Housing:	DP-LETU-184
Rotor Bearings & Housing:	DP-LETU-160
Run / Stop Switch Box:	GA-CTRL-008A
LE-DL-600 Diversion Controller:	GA-CTRL-001A

Warranty

Your *LE-600 Turbine* carries a two-year warranty from the original purchase date. Please keep your receipt as proof.

During the warranty period any component found to be defective in material or workmanship will, at the discretion of *Leading Edge Turbines*, be replaced or repaired at no charge.

For minor component failures, replacements may be sent directly to the customer / dealer for replacement. For more serious defects we may suggest a 'return-to-base' arrangement for replacement or repair. In all cases *Leading Edge Turbines* will take reasonable action to ensure customer satisfaction. You will always receive a warm, courteous service in or out of your warranty period.

Your turbine must be installed and operated in accordance with this guide and local electricity codes. Failure to do so will result in this warranty becoming null and void. Any unauthorised modifications to the turbine design will void the warranty and may compromise the safety of the machine.

What is not covered by your warranty?

If your turbine is commissioned by *Leading Edge Turbines*, the following are excluded from the warranty

- Damage caused by the neglect of periodic maintenance in the manner recommended.
- Damage caused by repair or maintenance performed using methods not specified by *Leading Edge Turbines* or by non-authorised dealers of *Leading Edge Turbines'* products.
- Damaged caused by the use of non-genuine parts, or from the use of liquid agents or lubricants in or on the turbine, tower or control equipment.
- Damage caused by operating the turbine in conditions outside of those specified in the Owner's Guide – including, but not limited to, allowing the turbine to run off-load.
- Damage caused by modifications to the turbine, tower or control equipment not approved by *Leading Edge Turbines*.
- Damage caused to the turbine, tower and control equipment by improper storage or transport.
- Damage caused by lightning strikes.
- Damage due to extremely high winds and storm conditions (60 mph+).
- Damage caused by flying debris.
- Aesthetic phenomena that do not affect performance.
- Damage caused by unsatisfactory installation of the turbine, tower and/or control equipment.
- Damage caused by unsatisfactory tower / support structure design.
- Damage caused by incorrect connection to external electrical equipment, or failure to observe current regulations concerning connection to external electrical networks, equipment or any other devices.

If you should experience a problem with your turbine, your first 'port-of-call' should be the reseller or installer from whom you purchased the product. They will be able to resolve the problem quickly and efficiently. If you are unable to contact the original reseller, then please contact us directly. Please quote the serial number of your turbine when dealing with warranty issues. The serial number can be found on the nameplate positioned on the underside of the chassis.

Disclaimer

- All specifications are subject to change without prior notice.
- The information given in this User Manual is believed to be accurate and reliable. *Leading Edge Turbines* assumes no responsibility for omissions or inaccuracies.
- The user of this information and product assumes full responsibility and risk.
- The *LE-600* turbine is a source of electrical power. It must be installed in accordance with local building and electrical regulations. Consult your local planning (zoning) office for details.
- The *LE-600* turbine has moving parts that may cause injury due to poor installation and unsafe operation. *Leading Edge Turbines* assumes no responsibility for problems caused by unsafe or unsatisfactory installation or operation.

Designed & Manufactured in the UK by:
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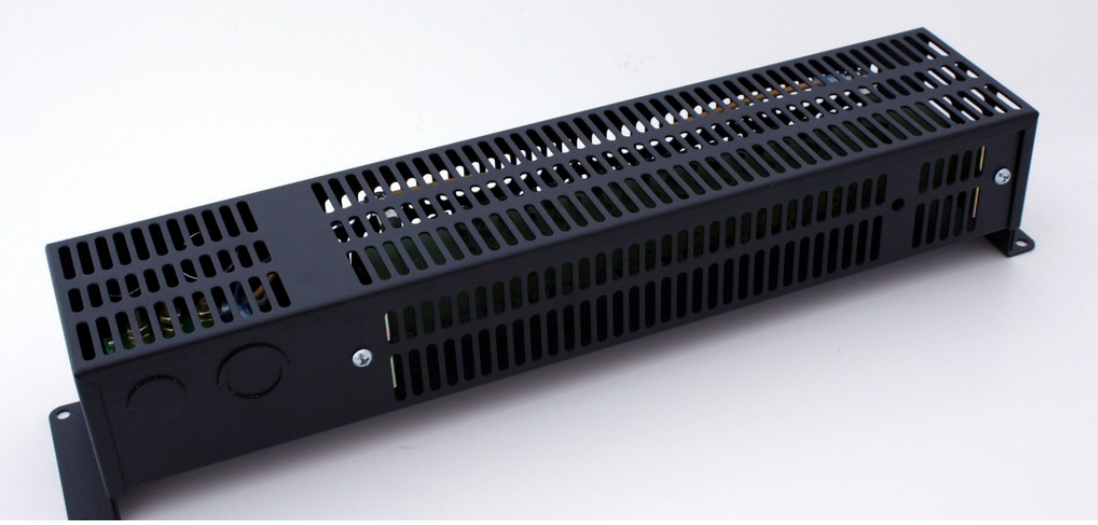
CE

Compliant with
EN BS 61400-2: Safety of Small Wind Turbines

Appendix 1: LE-DL-300 Charge Controller User Manual



Introduction

Please read this manual thoroughly before attempting to assemble, install or operate your LE-DL-300 Charge Controller. This will assure optimum performance and safety.

The LE-DL-300 Series Dump Controller and Load is an integrated solution designed to prevent 12 or 24 Volt batteries from overcharging. It is designed to be used with small wind systems operating a LE-600 turbine. Compact and easy to install, the LE-DL-300 was developed especially for the LE-600 turbine. It incorporates a 300 Watt resistor / heater and controller board in a stout powder coated steel enclosure. For the *LE-600* wind turbine, two LE-DL-300s work in parallel.

Operation & Specification

As the *LE-600 Turbine* charges the batteries, the State of Charge (SOC) and battery voltage will rise. Once the batteries reach full capacity, the dump load controller begins to bleed power from the turbine into the dump load. This energy is then dissipated as heat into the surrounding environment. More or less power is diverted to the dump load according to how much power is being supplied to the battery and also in relation to the state of charge of the battery.

The LE-DL-300 Features:
PWM (Pulse Width Modulation) for highest charging performance without flicker
Selectable three-stage charging or over-voltage protection mode
Selectable for sealed or flooded batteries using jumpers

Power, 12 Volt version, DL300-12:
Recommend fuse or circuit breaker: 30 Amps
Integrated load resistor: 300 Watt, wire wound
Quiescent current when not load dumping: 2.6 mA @ 12 Volts

Power, 24 Volt version, DL300-24:
Recommend fuse or circuit breaker: 15 Amps
Integrated load resistor: 300 Watt, wire wound
Quiescent current when not load dumping: 3.0 mA @ 24 Volts

Connections:
#10-32 brass screws for V+ and V-
Two 1/2” / 3/4” concentric NPT knockouts and two 1/2” NPT knockouts

Mounting:
Mounts to vertical concrete, metal, drywall, or other non-flammable surfaces.
Uses four #10 screws
Body sits 19 mm out from wall
Enclosure suitable for indoor mounting

Weight and Dimensions:
Dimensions: 88 mm wide, 95 mm tall, 470 mm long (3.375 x 3.75 x 18.5 in)
Weight: 1.94 Kg (4.28 pounds)
Shipping Dimensions: 102 mm wide, 108 mm tall, 508 mm long (4.0 x 4.25 x 20 in)
Shipping Weight: 2.15 Kg (4.75 pounds)

Materials:
Enclosure: 18-gauge mild steel, powder coated black
Circuit board: FR-4, 1.6 mm (0.062 in), double sided, plated through holes, solder mask, silk screen, gold plating
Hardware: stainless steel, zinc plated steel, aluminium, and Nylon

Safety Precautions

Safety must always be your primary concern during the assembly, installation and operation of your *LE-600 turbine* and DL300 Charge Controller. Always be aware of the risks involved with mechanical and electrical installation work. If in doubt about any issue regarding your turbine system, please seek further assistance before proceeding.

Mechanical Safety Hazards:
Whilst installing the DL300 Charge Controller or when performing routine inspection or maintenance, always stop the turbine by activating a stop switch.

Electrical Safety Hazards:
The *LE-600* generates rectified DC voltage and the LE-DL-300 controller also operates at these voltages. Even at these low voltages there are inherent risks. Caution should always be used when connecting an *LE-600 Turbine* or LE-DL-300 controller to the electrical system.

Make sure that you have followed the cable-sizing guidelines so that that the correct size of cable has been selected. If a cable of insufficient cross-sectional area is used at any point in the electrical system, heat will build up in the cables causing a potential fire hazard. A properly sized fuse or circuit breaker should be used in the cables connected to the battery. This will stop the risk of short circuit currents.

Batteries used in renewable energy systems can deliver a serious amount of current. A short circuit in the battery circuit can lead to hundreds of amps flowing through the battery cables. This will cause a heat build-up and ultimately an electrical fire. Batteries are also susceptible to explode when shorted. Always use insulated electrical tools when working on the battery's electrical connections.

Batteries are very heavy. Do not attempt to move batteries by yourself. Always use manual handling tools and an assistant.

Always keep lead-acid batteries the correct way up. Do not allow the acidic electrolyte to spill or come into contact with your skin or face. Always follow the manufacturer's safety instructions when handling lead-acid batteries.

Please use common sense when installing and operating your turbine and LE-DL-300 Charge Controller

Electrical Installation

Please refer to electrical schematic for appropriate generic wiring diagrams. In a battery charging renewable energy system, there may be different ways of wiring small wind turbines, photovoltaic panels, charge controllers and batteries together. This type of system will often expand 'organically', but the following guidelines should be followed:

Location – The LE-DL-300 controller should be mounted in an adequately ventilated area, which is not exposed to direct moisture or spray. The dump load elements become hot during normal operation and should not be covered or blocked.

Gel or Flooded Batteries – An electrical jumper needs to be configured in order to make the controller more suitable for use with 'Flooded' or 'Gel' batteries. A jumper (supplied) should be applied to pins labelled '2.2' when the LE-DL-300 is to be used with flooded batteries. When the LE-DL-300 is to be used with Gel batteries, no jumper should be applied to pins '2.2'. **In any circumstance, no jumper should be applied to pins '2.1'.**

Use the correct voltage controller – A 12 V DL300 controller should only be used on a 12 V battery system. A 24 V DL300 controller should only be used on a 24 V battery system. Do not interchange.

Follow the appropriate electrical code **-** The electrical wiring of your *LE-600* and associated electrical systems must be done in accordance with national and local electrical codes and regulations.

Do not connect the turbine or batteries during the installation **-** Ensure that the turbine is not running or connected to the batteries during the installation or wiring process. Connect the output cables of the turbine together to prevent the rotor from starting up.

Galvanic corrosion of electrical joints **-** Try to avoid connections between dissimilar metals. For example, connecting copper and aluminium together will result in galvanic corrosion of the connection. This will increase the electrical resistance of the connection (wasting energy), and reduce the mechanical integrity of the joint. Where possible, use a fluxed solder to make electrical joints.

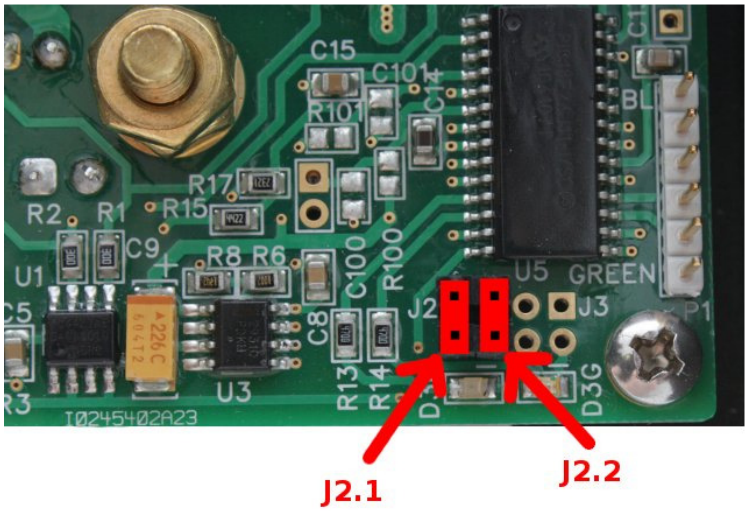
Protect the cables **-** The power transmission cables must be protected from mechanical damage and fatigue. Run the cables through an approved conduit / trunking.

Cable strain relief **-** Prevent mechanical strain on all cables. Cable ties or cable glands are a good way to prevent mechanical strain on the cables.

Fuses **-** The LE-DL-300 controller should be protected with a suitably rated 'slow-blow' DC fuse or DC circuit breaker. Please refer to the table below for the correct rating. The fuse or breaker should be positioned between the DL300 and batteries (on the positive cable)

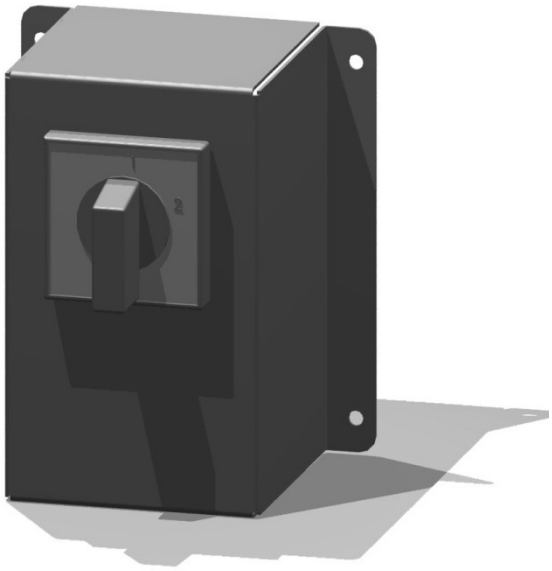
Nominal Voltage	DC Fuse / DC Circuit Breaker Rating
12V	30 Amp
24V	15 Amp

Jumper Positions of DL300 Controller



Electrical Jumper

An electrical jumper needs to be configured in order to make the controller more suitable for use with 'Flooded' or 'Gel' batteries. A jumper (supplied) should be applied to pins labelled '2.2' when the LE-DL-300 is to be used with flooded batteries. When the LE-DL-300 is to be used with Gel batteries, no jumper should be applied to pins '2.2'. **In any circumstance, no jumper should be applied to pins '2.1'.**



Introduction

Please read this manual thoroughly before attempting to assemble, install or operate your Universal Run / Stop Switch. This will assure optimum performance and safety.

The Universal Run / Stop Switch is a solution designed to allow the user to brake dynamically an LE-300, LE-600 or LE-2000 turbine at will. This is achieved by disconnecting the power output of the turbine from the relevant load and diverting it to a short circuit which then applies the dynamic braking effect on the permanent magnet alternator of the turbine. This will bring the turbine to a near stop for maintenance, or to allow the turbine to ride out high winds and storms safely.

The Universal Run / Stop Switch can be used with turbines of different manufacture as long as the relevant turbine has the following characteristics:

3-phase Wild AC not exceeding 500 V & 16 A
Wild DC not exceeding 150 V & 10 A
Mechanically and electrically capable of dynamic braking

Operation & Specification

The Universal Run / Stop Switch should ideally be operated during low speeds as repeated use at high speeds may cause damage to the turbine head (it was not designed to withstand repeated dynamic braking operations).

The switch has 2 positions:

Position 1: Turbine 'Stop' position. The turbine is dynamically braked and may be seen to rotate very slowly.

Position 2: Turbine 'Run' position. The turbine output is allowed to flow straight through the switch to the relevant output.

Safety Precautions

Safety must always be your primary concern during the assembly, installation and operation of your turbine and other associated equipment. Always be aware of the risks involved with mechanical and electrical installation work. If in doubt about any issue regarding your turbine system, please seek further assistance before proceeding.

Mechanical Safety Hazards:
Whilst installing the Universal Run / Stop Switch, ensure that the turbine is suitable restrained and not allowed to operate during the installation.

Electrical Safety Hazards:
The *LE-600* generates rectified DC voltage and the Universal Run / Stop Switch also operates at these voltages. Even at these low voltages there are inherent risks. Caution should always be used when connecting LE-600 or other equipment to the electrical system.

The *LE-600* & LE-2000 can generate high voltage AC, and the Universal Run / Stop Switch also operates at these voltages. Such voltages bring with them significant risks. Caution should always be used when connecting an LE-2000 or other equipment to the electrical system.

Ensure that you have followed the cable-sizing guidelines in order to select the correct size of cable. If a cable of insufficient cross-sectional area is used at any point in the electrical system, heat will build up in the cables causing a potential fire hazard. A properly-sized fuse or circuit breaker should be used in the cables connected to the battery. This will stop the risk of short circuit currents.

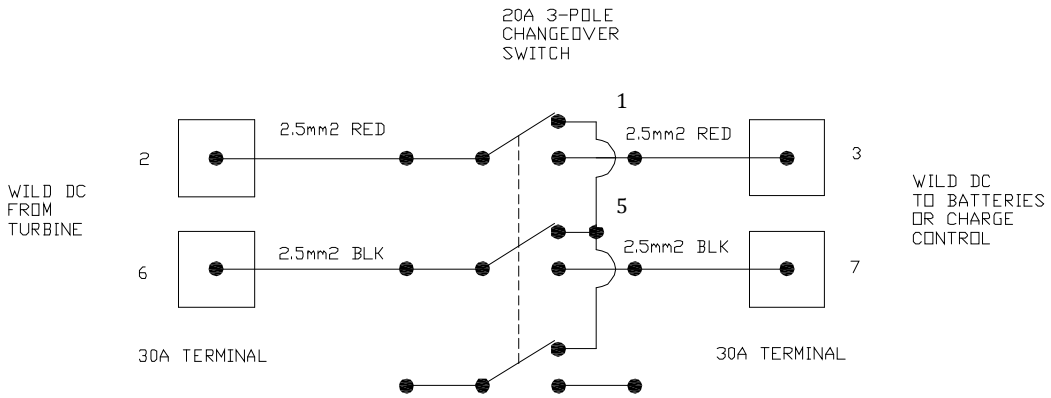
Batteries used in renewable energy systems can deliver a serious amount of current. A shorting of the battery circuit can lead to hundreds of amps flowing through the battery cables. This will cause a heat build-up and ultimately an electrical fire. Batteries are also susceptible to explode when shorted. Always use insulated electrical tools when working on the battery's electrical connections. Batteries are very heavy. Do not attempt to move batteries by yourself. Always use manual handling tools and an assistant. Always keep lead-acid batteries the correct way up. Do not allow the acidic electrolyte to spill or come into contact with your skin or face. Always follow the manufacturer's safety instructions when handling lead-acid batteries.

Ensure that the Universal Run / Stop switch is correctly wired as per these instructions and wiring schematics. Incorrect wiring may lead to a short circuit being placed across the batteries which can lead to fire or explosion.

Please use common sense when installing and operating your turbine and associated equipment.
Installation

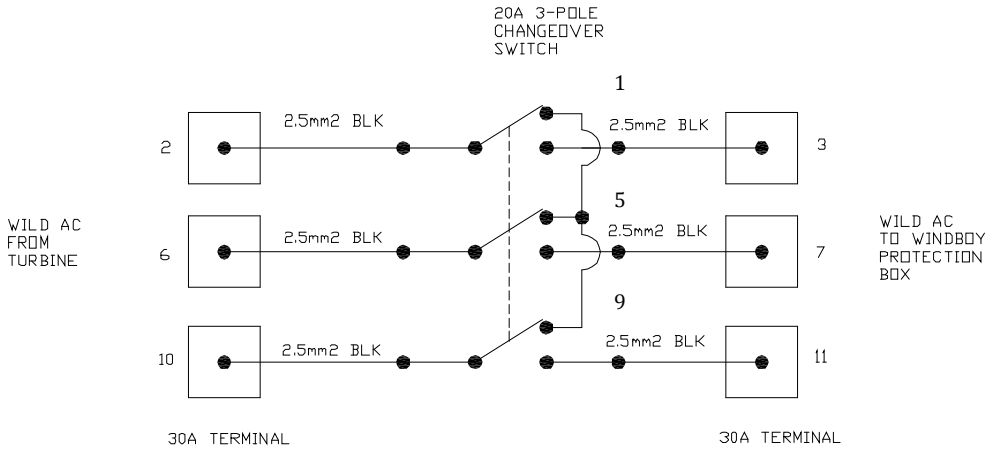
Please refer to electrical schematic for appropriate generic wiring diagrams.

The Universal Run / Stop Switch can either be mounted in the enclosure box (supplied), which, in turn, can be mounted on an internal panel, or the switch can be integrated into an existing panel. If the unit is to be integrated into an existing panel, a suitable cut-out, as detailed on the wiring diagram will need to be made.



Switch Wiring for LE-300 Turbine:

Switch Wiring for LE-600 & LE-2000 Turbine:



Panel Cut-out for Integrated Installation: